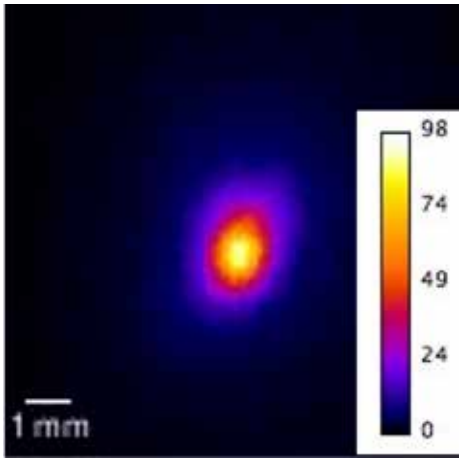
Compressed, Short-Pulse Ion Beams at the Neutralized Drift Compression Experiment

P A Seidl[1*], J J Barnard[2], A Friedman[2], E P Gilson[3], D Grote[2], Q. Ji[1], I D Kaganovich[3], A Persaud[1], W L Waldron[1], M Zimmer[4] and T Schenkel[1]

[1]Lawrence Berkeley National Laboratory, Berkeley, California, USA
[2]Lawrence Livermore National Laboratory, Livermore, California, USA
[3]Princeton Plasma Physics Laboratory, Princeton, New Jersey, USA
[4]Technische Universität Darmstadt, Germany

* PASeidl@lbl.gov

We will summarize the recent experiments with intense short pulses of ion beams on the Neutralized Drift Compression Experiment (NDCX-II) at Lawrence Berkeley National Laboratory [1], where we have achieved 1-mm beam spot radius within 2.5 ns full-width at half maximum. The ion kinetic energy is 1.2 MeV. To enable the short pulse duration and mm-scale focal spot radius, the beam is neutralized in a 1.5-meter-long drift compression section following the last accelerator cell. A short-focal-length solenoid focuses the beam in the presence of the volumetric plasma that is near the target. In the accelerator, the line-charge density increases due to the velocity ramp imparted on the beam bunch [2]. The scientific topics to be explored are warm dense matter [3], the dynamics of radiation damage in materials [4], and intense beam and beam-plasma physics [5] including select topics of relevance to the development of heavy-ion drivers for inertial fusion energy [6].



The transverse (x, y) distribution of the He^+ beam at the target plane is shown with a color calibration bar indicating the relative intensity.

Below the transition to melting, the short beam pulses offer an opportunity to study the multi-scale dynamics of radiation-induced damage in materials with pump-probe experiments [7,8], and to stabilize novel metastable phases of materials when short-pulse heating is followed by rapid quenching [9]. First experiments used a lithium ion source; a new plasma-based helium ion source shows much greater charge delivered to the target [10].

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